Frequency stabilization of the lasers for precision spectroscopy

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Research Outline

- The frequency stabilization of a diode laser for precision spectroscopy

We research the frequency stabilization of External cavity diode lasers(ECDL) with Doppler-free absorption signal of Ytterbium(Yb) and Rubidium(Rb) atoms. These ECDLs are used for laser cooling of Yb and Rb atoms.

Figure 1 shows a photograph of the homemade ECDL. We have built an ECDL with the Littrow configuration. We used a commercial diode laser chip. A peltier element controlled the temperature of the laser chip. We used a collimation lens and a holographic grating in the external cavity with a cavity length about 10 mm. The first order diffraction of the grating was back-reflected into the diode laser to stabilize the frequency of the ECDL. We achieved continuous frequency tuning by tilting of the grating with the help of a piezoelectric transducer (PZT). The mode-hop free scanning range was about several GHz. The typical output power of the ECDL is several ten mW.

Figure 2 shows the first derivative of the saturated absorption signal of the Yb $^1S_0$–$^1P_1$ line, which resulted from three even and an odd isotopes. Isotopes ^{172} Yb and ^{173} Yb were not resolved. The laser frequency stabilization was realized by feed-back controlling of PZT for controlling the cavity length using the error signal.

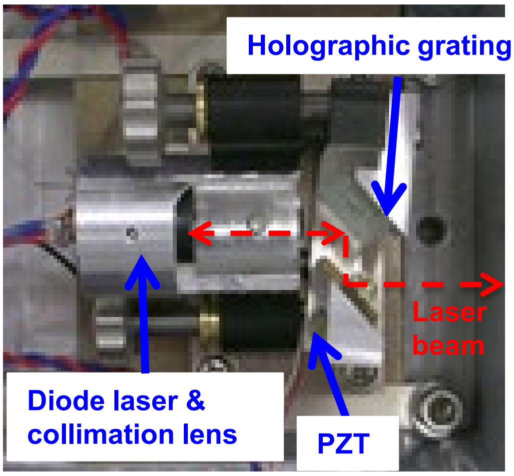

Fig. 1. The photograph of the homemade ECDL.

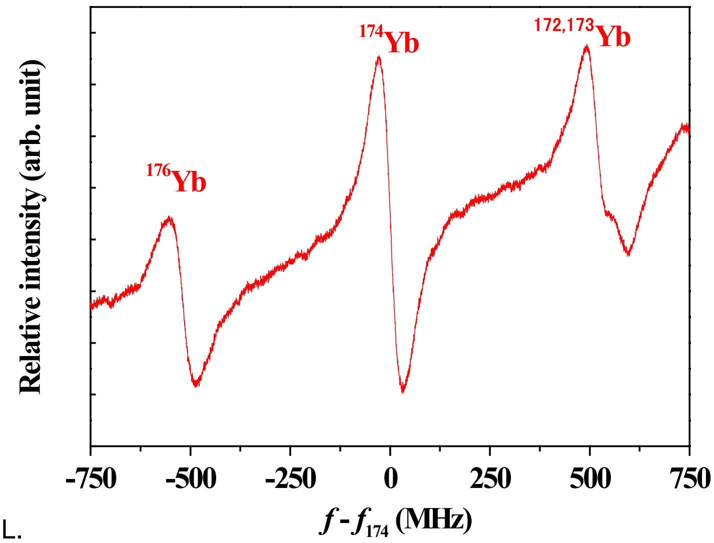

Fig. 2. The first derivative of the saturated absorption signal of the Yb $^1S_0$–$^1P_1$ line. The signal shows the absorption signal of the four Yb isotopes. Isotopes 172 and 173 were not resolved.